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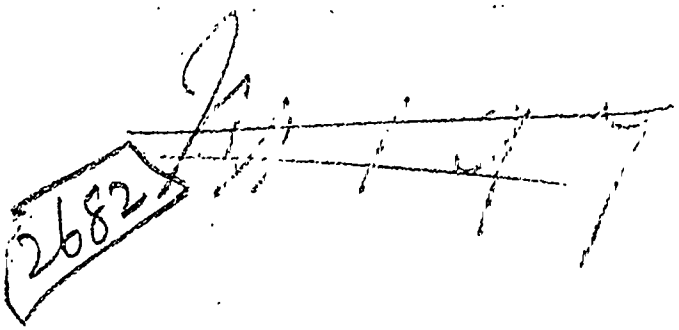

INDIAN RIVER NAVIGATION.

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INDIAN RIVER NAVIGATION.

A REPORT

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ADDRESSED TO THE COMMITTEE OF GENTLEMEN FORMED FOR THE ESTABLISHMENT OF IMPROVED STEAM NAVIGATION UPON THE RIVERS OF INDIA.

BY JOHN BOURNE, C.E.

ILLUSTRATING THE PRACTICABILITY OF OPENING UP SOME THOUSANDS OF MILES OF RIVER NAVIGATION IN INDIA, BY THE USE OF A NEW KIND OF STEAM VESSEL, ADAPTED TO THE NAVIGATION OF SHALLOW AND SHIFTING RIVERS.

WITH AN ILLUSTRATIVE MAP.

LONDON:
WM. H. ALLEN AND CO.
1849.

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INDIAN RIVER NAVIGATION.

TO THE GENTLEMEN INTERESTED IN THE ESTABLISHMENT OF STEAM VESSELS OF AN IMPROVED KIND UPON THE RIVERS OF INDIA.

GENTLEMEN:—

Indian River Navigation an object of national importance.

IN the remarks I have to offer upon your important proposal to establish a superior description of Steam Vessels upon the rivers of India, I feel it necessary in some measure to depart from the ordinary form and usual limits of an engineering report, both because the novelty of the subject demands a more complete elucidation than would be necessary in the case of an English project; and because your present limited design, being but a part of an articulate system of steam communication extending over India, must be considered in regard to its ultimate developements before any judgment can be formed of the national advantages of the undertaking. To Shareholders, no doubt it will, under ordinary circumstances, be a sufficient warrant for the prosecution of any enterprise, that it holds out a fair prospect of a profitable return; but to justify any encouragement on the part of the Government, it is necessary to shew that substantial advantages will be gained by it for commerce or for the public service; and the encouragement of the

Necessity of Government encouragement in introducing the proposed improvement

Government, in some shape or other, appears to me indispensable to the success of your design. The Government has already manifested its appreciation of the advantages of Steam Navigation upon the rivers of India, by the establishment, many years ago, of Steamers upon the Ganges, whereby, at a comparatively small expense, great benefits have accrued to the community of Bengal; and after the favourable issue of the first experiment, it cannot be supposed that the Government should now withhold encouragement from any well-considered measure by which those benefits would be heightened and extended.

The rivers of India are uniformly shallow, and are much obstructed by banks and shoals, which greatly embarrass the navigation; while the beds of the rivers are, in many cases, liable to change their positions during every inundation. The Ganges is the only river upon which it has hitherto been found practicable to establish Steam Vessels for commercial purposes; and even upon the Ganges the Steamers cannot ascend higher than Allahabad, situated about midway between Calcutta and Delhi, at the confluence of the Jumna and Ganges. The Steamers are unable to run during the night, lest they might get upon shoals from which their subsequent removal would be difficult, and the progress made in ascending the stream is consequently not more than 50 or 60 miles a day. Notwithstanding every precaution, however, the vessels are perpetually getting aground, and frequently stick in the river for days or weeks together, so

that the voyage is necessarily very tedious, and consequently expensive. In the course of a professional visit to India I recently had occasion to make, in connection with the operations of one of the Indian Railways, I had to descend the Ganges from Mirzapore to Calcutta, and I was struck with the imperfect adaptation of the steamers on the river to meet the difficulties peculiar to their vocation. It was obvious to my mind, that a great river like the Ganges, full of shoals and quicksands, and perpetually shifting its channel, was practically unimproveable; and the inference, therefore, was unavoidable, that the Steamers must be adapted to the river, since the river could not be adapted to the Steamers. This adaptation appeared to me to be accomplishable without difficulty, by suitable mechanical arrangements; and I could only account for the continued absence of such an adaptation, on the hypothesis, that few mechanical engineers had ever visited India, and that the engineers at home were without the local or circumstantial knowledge necessary to enable them to prescribe a suitable remedy. Since my return to England I have proceeded to mature the conception which suggested itself to me upon the spot; and I find, that whereas the most suitable of the present Ganges boats carry only a cargo of about 60 tons upon a draft of about 3 feet of water, and realize a speed of only 6 or 7 miles an hour, while they are unable to surmount or get off banks in the river by any prompt or effectual process, it is practicable to

Inefficiency of ordinary Steamers for Indian rivers, and necessity of a new kind.

Messrs. Boulton and Watt offer to construct an efficient vessel of the kind proposed.

construct a vessel under other arrangements which shall carry 250 tons of cargo upon 12 inches draft of water, with a speed of 15 miles an hour, and which at the same time shall be capable of running over the shoals on appropriate wheels provided for that purpose. Messrs. Boulton and Watt's letter, offering to construct a vessel upon this plan which shall realize all my anticipations, is appended hereto.

The alternative modes of introducing this improved system of river navigation into India which most readily suggest themselves, are, either that the experiment should be tried by Government, in the same manner as the original experiment of introducing Steamers upon the Ganges in 1834 was tried; or that a private Company should be formed, under the auspices of the Government, which should carry on its operations by means of vessels of the improved description. There would not be much difficulty, I imagine, in the successful institution of an efficient Company for carrying forward inland Steam Navigation in India, provided the Government granted it a Charter for the exclusive use of the improved vessels in India for a specified term, and agreed to surrender to it, at a valuation, the Government Steamers upon the Ganges, with the business attaching thereto. Nevertheless, it might be advantageous, in a case in which the benefits consequent upon success are so great, and the prospects of success so promising, that the Government should also, itself, take steps with a view of introducing the improved Steamers as speedily as possible.

The Government has generally been the pioneer of useful improvement in India, as indeed any Government largely in advance of the intelligence of its subjects must necessarily be; and as the Government can test the advantages of the improvement more promptly and more effectually than private parties, and has the prestige of success arising from the satisfactory issue of the former experiment, it appears very desirable that the Government should introduce this step of improvement also, leaving to private parties its subsequent developement, as applied to purposes of commerce. This course does not appear to me to be inconsistent with the rule of the Indian Authorities, to postpone the introduction of mechanical improvements into India until they have been practically adopted in this country; for such a rule, it is obvious, can only have operation in the case of devices of equally exigent necessity in both countries, and cannot extend to arrangements applicable to India alone. If there had been rivers like those of India in this country, it would be reasonable to look to this country for precedents of construction in Steamers appropriate for such rivers; but under existing circumstances, India is no more justified in looking to the common practice of England for the pattern of a Steamer, than for the fashion of a turban, or the form of a punka. Before there can be relevant precedent of invention, there must be a corresponding precedent of necessity; and where the necessity is new, the only judicious course is to adapt the means as

Futility of expecting patterns of vessels proper for India on the rivers of England.

Benefits of opening the rivers of India to Steam Navigation.

completely as possible to the end proposed to be attained. Instead, therefore, of exporting vessels of the English type to India to meet difficulties they were never intended to encounter, the safest, and consequently the least experimental course, is to adopt such a configuration, and such mechanical arrangements, as are best calculated to meet the difficulties which are known to exist; and in England this is precisely the course which, under like circumstances, would be pursued.

The effect of introducing Steamers such as I have described upon the rivers of India must be to open up the whole interior of the country to commerce, by establishing a cheap and expeditious mode of conveyance between the interior and the coast. Not only may the Ganges and Jumna be navigated from Calcutta to Delhi uninterruptedly throughout the year, but many of their larger tributaries, such as the Soane, Gogra, Gunduck, Goomty, and Chumbul, may also be navigated with great benefit to commerce. Such rivers as the Godavery, Nerbudda, and Tapty, which communicate with the cotton districts in the heart of the Deccan, may also be thus turned into great steam highways for bringing cotton and other products of the interior to the coast, and for transmitting English manufactures in return. The Indus, also, and its five tributary rivers flowing through the Punjaub, will be all made accessible by means of Steamers of the kind proposed, whereby a navigation of some thousands of miles will be opened, and the effect of which

will be to enable the manufactures of England to supplant those of Russia in the markets of Central Asia. The system of water carriage possessed by Russia on the Volga, running into the Caspian Sea, gives such facilities to the Russian merchant in the transport of his wares, that he can undersell the manufactures of this country in the bazaars of Turkestan and Cabool; but the effect of establishing Steamers upon the Indus, of the kind now proposed, would be to draw those countries nearer to Bombay, whereby the current of trade would be reversed, and English goods would supplant those of Russia in most of the markets of the East.

Imperfections of the existing modes of navigation

THE GANGES.

In the Ganges, as in most of the rivers of tropical countries, there is a yearly inundation, during which there is an abundant depth of water for purposes of navigation; but in the dry season the depth of the channel in many parts between Allahabad and Calcutta does not exceed 3 feet 6 inches, and sometimes it is even less than this. The river begins to fall in October, and continues falling through November, December, January, February, March, April, and May: during April and May, and sometimes half of June, the river is at its lowest, and after that it begins to rise from the melting of the snows in the Himalaya and the rains which fall in Bengal. In the dry season the average passage by Steamer from Calcutta to Allahabad is 24 days, and from Allahabad to Calcutta 15 days;

Practicability of navigating the Jumna and Bhaugiruttee during all seasons.

and during this season the average velocity of the current does not exceed $2\frac{1}{2}$ or 3 miles an hour; whereas during the rains, although the current is then much stronger, the average passage upwards is 20 days and down 8 days. This disparity is mainly due to the circumstance of the Bhaugiruttee branch of the Ganges, through which the navigation is pursued during the rains, being too shallow during the dry season to enable the Steamers to use it; and they have consequently at such times to pursue a most circuitous course through the Sunderbunds and up the Gorace river, by which the length of the voyage is increased from 787 miles to 1147 miles. If an available speed of 10 miles an hour against the stream, including stoppages, be obtained from the new kind of Steamer—which with a speed of 15 miles an hour in still water appears to be a reasonable anticipation—the voyage from Calcutta to Delhi will be performed in 78 hours or about $3\frac{1}{2}$ days; but it would be too much to expect that this anticipation should be strictly fulfilled. The minimum depth of water in the Bhaugiruttee is 2 feet, and that river therefore will be always accessible to Steamers drawing only one foot of water. The breadth of the Bhaugiruttee varies from 200 to 450 yards.

By the Report of Capt. Smith's operations in the Jumna, it appears that the dangerous rocks which formerly obstructed the navigation of that river have now been removed, and the minimum depth of water between Allahabad and Delhi is about

2 feet in the dry season. There is a considerable dearth of official information touching the depth of this river; but Major Baker states that "between Agra and Delhi the stream of the Jumna, at no place and during no season, has a less depth than 18 inches to 2 feet"; and Capt. Smith, in his Report, speaks of a shoal with only 2 feet water upon it, which had been overlooked, and for the removal of which orders were accordingly given. It may reasonably be inferred that the other shoals of the river must have had more than 2 feet water over them, when that with 2 feet was ordered to be removed; for on no other supposition could the shoal referred to constitute any obstruction to the navigation. Whether the minimum depth, however, be over or under 2 feet, it appears clear enough that the river would be navigable in all seasons by a vessel drawing 1 foot of water. The narrowest part of the Jumna below Delhi is 200 yards wide, and the sharpest curve has a radius of 250 yards, measuring from the inner bank. The distance of Delhi from Allahabad is about 600 miles, following the windings of the river, and the time occupied in ascending the stream between those points would, at 10 miles an hour available speed, be about 60 hours or 2½ days, making a total of 6 or 7 days under steam from Calcutta to Delhi. The voyage, however, would be considerably longer under any circumstances which rendered it impossible to proceed at night; and it would be too much to expect that so rapid a voyage should be habitually attained.

Depth, width, and radius of curves of Jumna.

Praticability of navigating tributaries of Ganges and Jumna.

The main stream of the Ganges may be navigated by the improved vessel as high as Gurmucktesir, near Meerut. The Gogra, a large tributary of the Ganges, taking its rise in the Himalaya and running past Oude, could also be navigated by boats on the same plan, but of smaller dimensions than those intended for the Ganges; and the Gunduck, a river also falling into the Ganges and taking its rise in the Dhawalagiri mountain in Thibet, could also be navigated by the same means. The Goomty river, rising in the Himalaya, passing the important cities of Lucknow and Juanpoor, and falling into the Ganges below Benares, might, notwithstanding its sinuous course, be ascended by small Steamers, such as those proper for the Gogra and Gunduck, to a considerable height; and the Soane river, which falls into the Ganges above Patna, could also be navigated by Steamers of the proposed configuration. By thus opening up the tributary rivers of the Ganges, so far as can be profitably done, it may reasonably be expected that the traffic on the main stream would be itself increased; but the existing traffic upon the main Ganges has been already ascertained to be upwards of a million tons a year; so that it constitutes a larger amount than Steamers could hope to monopolize for many years to come. The Chumbul river could be navigated, by the improved Steamers, past Gwalior to Kotah, in latitude 25°, during all seasons of the year; and during the rains boats can ascend to the foot of the Vindhya mountains, on the northern bank of the Nerbudda.

In framing the estimates of the East-Indian Railway some years ago, I had occasion to examine with care the cost of transport upon the Ganges, both by native boats and by Steamers, and also the cost of conveyance by the road. I found that the cost of carrying goods up the river in native boats could not be taken at less than 1·59*d.* per ton per mile of direct distance, including interest and insurance; and down the river 1·15*d.* per ton per mile of direct distance, including interest and insurance; while, by the road, the cost was 3½*d.* per ton per mile. By the Steamers the rate of freight has fluctuated very much, in consequence chiefly of the demand for conveyance exceeding the room available; and when the spare tonnage was put up to auction, the freight realized was in some cases as much as £20 per ton measurement of 40 cubic feet. Latterly the freights have been materially lowered; but at the present time the average freights by Steam Vessels upon the river, taking the upward and downward voyages together, cannot be set down at less than 2½*d.* per ton per mile of direct distance, and the charge for passengers from Calcutta to Allahabad is £30, exclusive of provisions.

Cost of conveying goods and passengers on the Ganges.

The number of passengers travelling by the Steamers is not considerable, partly, no doubt, on account of the heaviness of the charge; but the quantity of goods is practically unlimited, and, with moderate rates of freight, the Steamers can always obtain more cargo than they are able to convey.

It has always appeared to me that the Steamers

Importance of opening the cotton districts to the sea.

upon the Ganges are totally inadequate to the present locomotive wants of the country; but the question of Inland Navigation has now to be viewed, not so much with reference to its present capabilities, as with reference to the new powers and capabilities it is about to acquire.

THE GODAVERY.

This is a river which, rising near Bombay, and flowing eastward through the heart of the cotton districts of the Deccan, empties itself into the Bay of Bengal at Coringa, to the north of Madras. Although capable of affording a commodious outlet for the cotton and other produce of Berar, and with a sufficient depth of water to enable navigation to be carried on throughout the year, the Godavery is nevertheless, up to the present time, without any system of navigation such as is possessed by the Ganges and other rivers. This anomaly is to be imputed, partly to the circumstance that the jungle in many of the districts through which the river flows comes so close to the water's edge, and is so impervious and entangled, as to prevent the boats from being tracked upwards against the stream; and partly to the exactions of the officers of the Nizam, who, however, would have no power over English vessels. In 1816 Messrs. Palmer and Co., of Calcutta, formed the design of establishing a navigation upon the Godavery and Wurdah of 400 miles in length, and with this object they removed certain obstructions out of the bed of the river; but

political events occurred which prevented the project from being carried into practical effect. As the river approaches the Rajamundry frontier, it has to pass through the Papkoonda mountains, where it is contracted from a mile and-a-half to a furlong in breadth, and consequently runs with great velocity, but there are no falls to obstruct the navigation. In various parts of the channel between Berar and the sea the depth during the dry season does not exceed 18 inches; nevertheless, as such a depth is sufficient for a Steam Vessel of the kind proposed, there is no difficulty in the establishment of an efficient system of Steam Navigation upon this river. Captain R. H. Fenwick, after a personal survey of the locality, says "That the navigation of the Wurdah, from Woonee to Kalisir, and of the Godavery, from Elgurp near Neermul to the coast, is practicable, there remains no longer any doubt"; and H. Chamier, Esq., the Secretary of the Madras Government, writing to G. A. Bushby, Esq., Secretary to the Government of India, in August 1840, suggests the propriety of a Steamer being put upon the Godavery, to facilitate the transport of troops to Nagpore. Mr. Secretary Chamier writes as follows:—"Captain Fenwick, in par. 10 of his letter, states that he considers the Godavery and Wurdah rivers navigable for mercantile purposes, and offering a more advantageous mode of conveying cotton from Berar and the Nagpore territories to the eastern coast, than on carts and bullocks by land." Mr. Chamier therefore adds:—"It appears, therefore, probable that Steamers like

Navigation of the Godavery and Wurdah to Oomrowty.

Probable traffic upon the Godavery.

those on the Ganges, might ascend the Godavery to a considerable distance, and afford great and important advantages, not only to trade, but especially for the conveyance of troops and stores for Nagpore and Jubbulpore." Major Cotton draws a still more favourable picture of the capabilities of the river for purposes of navigation. In his second Report, dated April 17th, 1845, he says:—"There are no falls in passing through the hills nor through its entire channel, nor, indeed, any obstructions of consequence. The timber rafts never come until the water is at its lowest, and has not more than 2 or 3 feet of water at the fords in the low country. The velocity of the current is 3½ miles an hour." It appears doubtful, however, whether there may not be some exaggeration in saying that the minimum depth is 2 to 3 feet at the shoals in the dry season; but there is every reason to believe that the depth is never less than 18 inches in the parts of the river specified by Captain Fenwick as navigable throughout the year; and this is a sufficient minimum depth for a Steamer able to surmount shoals, and drawing only one foot of water.

The distance of Nagpore from Woonee, in a direct line, is about 70 miles, which is somewhat less than the distance from Nagpore to Chandah. The distance of Oomrowty from Woonee is about 100 miles; but the Wurdah river ascends to within 20 miles of Oomrowty, and would be navigable by a smaller species of boat up to Natchengong, 30 miles below Oomrowty, where a fall in the river

occurs, and over which boats cannot pass except in the height of the rains.

Probable Traffic upon the Godavery.

As the Godavery has not yet been opened up to commerce there are no statistics available to shew what the traffic upon it would be. It is known, however, that the expense of transporting troops, ammunition, and stores, from Madras to Nagpore and Jubbulpore, is so considerable as to have suggested the propriety of putting a Steamer upon the river, mainly for the purpose of conveying them: and it is further known, that the quantity of cotton grown annually in Berar, and finding its way by expensive and difficult channels to the coast, is more than sufficient of itself to give a Steamer full employment. It appears, by the evidence given before the Parliamentary Committee appointed to inquire into the cultivation of cotton in India, that the traffic of the Berar district sometimes amounts to 80,000,000 lbs. annually, or 31,250 tons; and of this great trade Oomrowty is the entrepôt. This cotton is at present carried, by a most tedious and expensive land-journey of some hundreds of miles, either to Bombay or to Mirzapore; and the time thus consumed is so great, that the monsoon rains frequently set in while the cotton is still upon the road, whereby either great damage ensues from the mud and wet, or the journey has to be abandoned altogether, from the impassable state of the rivers when swollen by the rains. There can be no doubt, in my apprehension, that the larger part of the cotton of Berar would descend the Godavery, if

Probable Traffic upon the Godavery.

an efficient Steam Navigation were established upon that river, which would carry the article from the place of its production to the sea at a moderate rate of freight; and the quantity of cotton grown would probably increase with the new facilities given to its conveyance, while at the same time the price of the article would be diminished to the English manufacturer. It is obvious, too, that since it is about the time of the monsoon rains that the cotton has to be transported, those rains, instead of impeding, would extend and facilitate communication if the rivers be made the highways; and the rivers would be most available for active service precisely at the time when the roads are closed by the floods.

Besides cotton, a steamer upon the Godavery would carry downwards silk, linen, shell lac, turmeric, grain, goor, oil, hemp, tobacco, bees' wax, &c.; and upwards, cotton and woollen cloths, salt, saltpetre, spices, iron wares, and metals, &c. The quantity of these articles which would be available as cargo for a Steamer it is impossible at present to specify, but there can be no doubt that at least one steamer would find full and profitable employment. And when it is remembered that the Godavery, if navigated by Steam, would become the highway to the heart of the Deccan, and must transmit the accumulated produce of extensive districts, it will be obvious that the traffic, though of uncertain amount, cannot but be large; while the very fact of opening the river to Steam Navigation would not only divert the existing trade into a more

eligible channel, but also materially increase its amount.

Examination of the difficulties in navigating the Nerbudda.

THE NERBUDDA.

The Nerbudda river, falling into the sea near Broach, to the north of Bombay, constitutes the northern boundary of the Deccan, and runs through a country which, though naturally productive, has been but little opened to commerce. The Tapty, which pursues a course parallel to that of the Nerbudda, falls into the sea at Surat, nearer Bombay. The districts of Broach and Surat are both known to furnish cotton of a superior quality; and by the establishment of an efficient system of navigation upon the rivers, the production of cotton would be largely increased. The navigation of the Nerbudda, however, is rendered difficult by rocks and falls, which obstruct the channel, and also by the strength of the current: but the magnitude of these difficulties appears to have been much exaggerated by loose and groundless generalizations; and although the evidence upon the subject is conflicting, it appears that the river could, at a small expense, be rendered navigable from near Jubbulpore to the sea —a distance of between 400 and 500 miles in a direct line—by boats of considerable burden. In a Letter from the Honourable Court of Directors of the East-India Company (Marine Department), dated March 8, 1840. it is stated, "On reference to Capt. Ouseley's report, we find it asserted that, with the exception of the Dahree falls, there is no place from Bharagurha, near Jubbulpore, to the mouth

Mode of overcoming the difficulties of the Nerbudda.

that might not be rendered passable for such boats as are now used,—30 to 40 feet long, and 8 to 10 feet wide. All rapids could, with trifling expense, be rendered navigable. Sir J. Malcolm cites Matthews' opinion in favour of the same object between Hernphal and Mokree; and we think that, whilst the native surveyor's opinion remains substantially uncontradicted, it ought to be further investigated."

The Dahree falls are 40 feet high; and they could only be surmounted by an inclined plane, or by locks. An inclined plane of timber would be an inexpensive structure, as the finest teak timber grows in abundance upon the river banks.

From the sea to 11 miles above Tulluckwarra, a distance of 110 miles, there is no impediment to the navigation. There the Mokree falls, which are 6 feet high, occur, but they can be avoided by a side channel. The river, however, is obstructed by occasional rocks and rapids; but, by an inconsiderable amount of blasting, these impediments could be speedily removed. At the Hernphal, or Deer's Leap, the channel is contracted to a width of 40 yards, and the current is very rapid. At the Sarsa Darah falls there is a side channel available, by which the falls may be avoided. The Dahree falls of 40 feet, and perhaps, also, the Mundhar falls, of 10 feet high, would have to be overcome by inclined planes, up which the vessels would ascend, after the fashion of a patent slip, or in the manner followed on some of the American canals.

It will be obvious from this recital that the Ner-

budda presents difficulties in the navigation such as do not exist in the Godavery or the Ganges, arising mainly from the rocky nature of its bed; but this very peculiarity makes the Nerbudda an improveable river, inasmuch as any amelioration consequent upon the removal of rocks, or the deepening or widening of the channel, would be permanent and decisive. Of the importance of opening the Nerbudda to navigation no doubt can exist; and the practicability of accomplishing the necessary improvements at a moderate expenditure appears, from the reports of various engineer officers who have surveyed or sailed down the river, to be equally certain. To what point a Steamer of adequate power could ascend the river in its present condition appears doubtful; but the most judicious course would probably be for the Steamer to ascend the river as far as is practicable with safety, and for the obstructions to be cleared away progressively, from the mouth of the river upwards, the Steamer ascending higher every successive trip, in proportion as the obstructions were removed. The lower part of the Tapty is freer from impediments than the lower part of the Nerbudda; and a Steamer of the kind proposed could ascend to Talneir, in longitude 75°,—the minimum depth of water up to that point being 2 feet over the fords.

Nature of traffic upon the Nerbudda.

Supposing the Nerbudda to be opened to steam navigation, the commerce of central India would be attracted towards it, as affording the readiest outlet for the productions of all the countries lying be-

The Indus affords a highway to the markets of Central Asia.

tween the Godavery and the Jumna. Cotton, hemp, oil, seeds, sugar, rice, shell lac, hides, horns, and coal, would be brought down the stream; and British manufactures from Bombay, salt and salt fish, and articles from the Persian Gulf, would be carried upwards. The soil upon the banks of the Nerbudda, moreover, is known to be of a kind favourable to the growth of indigo, which, indeed, grows wild in those districts to a great extent; and the opening of the river would probably have the effect of inducing the cultivation of this and other valuable crops. The opium of Malwa, on the northern bank of the Nerbudda, is the best produced in India; and the same remark applies to the Malwa tobacco, which is much prized. From Broach there is upwards of seven millions of pounds of cotton annually exported at present; and the opening of the Nerbudda and Tapty to steam navigation would probably have the effect of increasing largely the export of cotton, and correspondingly augmenting the import of British manufactures.

THE INDUS AND ITS TRIBUTARIES.

In former times the Indus was the great highway of commerce between India and Central Asia; but upon the dismemberment of the empire of the Great Mogul the river fell under the power of a multitude of petty chiefs, whose exactions gradually extinguished the traffic. One consequence of this revolution was, that Cabool, Bokhara, and Persia, instead of being supplied from India with manufac-

tured goods, as had previously been the case, received most of their supplies from Russia, which, from the facilities of conveyance afforded by the Volga, running into the Caspian Sea, was enabled to come into the markets of the East upon eligible terms. These advantages possessed by Russia have, it is understood, been latterly augmented by the establishment of Steam-vessels upon the Volga and the Caspian; and the Russians are now supplanting the English manufactures in the Punjaub, and even threatening to do so in the north-west provinces of Bengal. The Indus, though a large river, is but ill adapted to navigation by steam, being in many places shallow and full of shifting sand-banks, among which it is impossible to discover the most eligible channel; and although the river is too deep to be easily fordable, it is at the same time so full of shoals as to present nearly the same difficulties to navigation as if the depth nowhere exceeded 2 or 3 feet. Practically, the river is unimprovable, and the same remark applies to all its tributary streams; so that the Indus is not only unfitted for the reception, with advantage, of adequate Steam Vessels of the ordinary kind, but is incapable of being made better. By means of Steamers, however, of the kind now proposed, the Indus may be navigated from the sea to Attock with a remunerative cargo; the Jailum to Oin, the Chenaub to Aknur, the Ravee to Lahore, and the Sutlej to Ropur, above Loodheana, and the voyage may in general be pursued day and night, since a vessel drawing

Practicability of navigating the Indus and its tributaries by Steam.

The Indus and its tributaries navigable from the sea to the Himalaya.

only 1 foot water is not so likely to get upon a bank; and since, even should such an accident occur, efficient means are available for carrying her over it. The fall of the Indus, from Attock to the sea, being about 1 foot in the mile, the velocity of the current is necessarily greater than in the Ganges, but there would also be fewer stoppages; so that, with a velocity through the water of 15 miles an hour, an effective velocity of 10 miles an hour in ascending the stream might probably be realized. With this velocity the voyage from the sea to Attock would only occupy 94 hours; from the sea to Oin 92 hours; from the sea to Aknur 93 hours; from the sea to Lahore 101 hours; and from the sea to Ropur, on the Sutlej, 103 hours. Ropur is distant little more than 100 miles from Kurnaul, upon the Jumna, to which point it has latterly been proposed to carry a canal from the Sutlej for purposes of irrigation; and if this canal were made large enough to be suitable for navigation also, it would then be practicable to go from Calcutta to the Punjaub by inland water conveyance, and India would become an island. A canal of large dimensions, conducting water from the Sutlej to the Jumna, would not only have the effect of deepening the Jumna by restoring a volume of water exceeding that at present withdrawn for irrigation, but, by replenishing the Gagur, Sursooty, and other rivers now nearly dried up, fertility would be again given to the region of Hurreana, whereby, under suitable arrangements, the expense of the work would be abundantly defrayed.

There appears little doubt that it would be practicable to ascend the Indus by steam considerably higher than Attock; but there would be but little advantage in doing so, as at Attock the current of trade would pass westward into Cabool. The Jui Shir, or Cabool river, has, it is stated, been already ascended by a steamer as high as Jelalabad, although the river, in passing round the end of the Khyber mountains, runs with great violence; but an efficient vessel would be able to stem the current at all seasons, and, by carrying merchandize by this route into Cabool, the necessity would be obviated of having to convey it through the Khyber Pass, on the road from Peshawur to Jelalabad. The point in Cabool at which the steamer had to stop would of course become a dépôt for British goods, which would from thence be conveyed through the Pass between Hindoo Koosh and Koh-i-Baba, at Bamian, into most of the bazaars of Central Asia.

Imports of Cabool and Bokhara from India and Russia.

The imports of Cabool are indigo, cotton, sugar, calicoes, muslins and shawls; and the exports are horses, the madder of Ghuznee and Candahar, and fresh and dried fruits. The chief carriers of the trade are the Lohanee merchants, a pastoral race of Afghans who occupy the country eastward from Ghuznee to the Indus. The Lohanee caravan usually reaches Cabool about the beginning of June; and after the merchants have disposed of their goods they prosecute their journey onward to Bokhara. The imports which Bokhara receives from India are the same as those

Course of trade in Central Asia.

received by Cabool. About 2000 camel-loads of goods reach Cabool from India yearly, and about half this quantity is transmitted to Turkestan.

The imports into Bokhara from Russia are, white cloths, muslins, chintzes, broadcloths, velvets, brocade, nankeen, gold thread, cochineal, refined sugar, honey, furs, locks, iron, iron pots, wire, copper and brass, leather, paper, needles, inferior cutlery and jewellery, hardware, and a variety of other small articles. English broadcloth is much prized in Bokhara, but none reaches that country, except through Russia or Persia; from which countries, although its transmission is subject to heavy imposts, it can be brought at a cheaper rate than from India, in consequence of the expense of the land-carriage through Afghanistan, which, however, the opening of the Indus would in a great measure supersede.

Besides the Russian and Indian trade, Bokhara carries on a considerable traffic with China, by way of Cashgar and Yarkund. The imports to Bokhara from China are, China ware, musk, bullion, and tea. Of the latter article there are nine hundred and fifty horse-loads, or two hundred thousand pounds, transmitted annually, although the difficulties of the roads, and the long land-carriage through Thibet, necessarily much enhance the price. A horse-load of two hundred and fifty pounds costs sixty tillas in Yarkund, and sells for one hundred tillas in Bokhara. It is entirely green tea which is carried to Turkestan, and the best

comes from a place in China called Turkht, and is packed in small boxes of Banca tin, from whence it is called Banca tea. The sugar-candy of China is also imported into Turkestan, but being a comparatively cumbrous article, it cannot be carried by the same route as the tea, but is conveyed from China to Bombay, from thence up the Persian Gulf, and on by land to Teheran: from thence a large quantity is carried across the Caspian to the Bay of Balkan, from whence it is carried to Khiva, and a small quantity is also carried by way of Meshed. It is obvious, that if the Indus were available for commerce it would afford a much easier route for the produce of China to Khiva and Bokhara, than either the route through Thibet, or the route through Persia; and many of the commodities which find their way into Central Asia through circuitous routes, would necessarily take the route of the Indus, so soon as that channel of communication was properly opened up.

Course of trade in Central Asia.

The principal exports of Bokhara are silk, wool, and lamb-skins. The silk is chiefly produced on the banks of the Oxus, where the mulberry grows in the most luxuriant manner, and nearly all the inhabitants are engaged in rearing the silk-worm during the summer months. The lamb-skins of Bokhara are renowned throughout the East, and are only procured at Karahool, a small district lying between Bokhara and the Oxus. These skins are chiefly carried to Persia; but the risks of the transport are great, in consequence of the unsettled

Course of trade in Persia.

condition of the tribes between the two countries. From these causes it is not possible to negociate a bill between Meshed and Bokhara, and the cost of transport is very high.

The manufactures of Russia find ready access into Persia by the Caspian; but Tabreez and Teheran also receive Russian goods by way of Tiflis and the Caucasus. Latterly a route has been opened for English goods into the northern parts of Persia by way of Trebizonde, from which much benefit has accrued—the southern districts being supplied with English goods from Bushire, on the Persian Gulf. To the north-west of Bushire the Karoon, a large and navigable river, ascends into the heart of Persia; and, under suitable arrangements, goods might be carried by this route to within a comparatively short distance of Ispahan.

COAL.

The supply of coal for the steamers established upon the various rivers of India forms an important part of the general question; but the point is fortunately one which is easily disposed of, as coal has been found near the sources of the several rivers which it is proposed to navigate; and the stations on the upper portions of the rivers can consequently be supplied from local sources—the coal being floated down in the rains, and stored in appropriate situations. At the mouths of the several rivers supplies of English coal would be available; and it would be desirable to use English

coal as far as possible, since its quality is better ascertained than that of the local deposits. The Burdwan coal sells in Calcutta for 21*s.* per ton; but the English coal is dearer, being seldom lower than 26*s.* or 28*s.* per ton. For the supply of the stations on the upper parts of the Ganges and Jumna the coal found in the vicinity of Hurdwar could be used, and the coal found on the Soane, and other localities contiguous to the river, could also be used for the intermediate stations. For the upper stations of the Godavery and the Wurdah river the coal-fields of Beitool and Seuni could be rendered available; and on the Nerbudda, near Hossungabad, and also near Jubbulpore, coal of excellent quality is abundantly found. In the range of hills, denominated the "Salt Range," stretching across the Punjaub from Attock towards Seharunpore, coal, it is said, is abundantly found; and these deposits would, in all probability, be available for the supply of steamers on the several rivers of the Punjaub. In Cutch also, near the mouth of the Indus, coal has been discovered; but it would be preferable, in the outset at least, to use English coal for the purpose of *ascending* the rivers, although the coal procured from native sources were used during the descent. The lower parts of the several rivers having in general a slow current and the aid of ascending tides, offer but few difficulties to the ascent of coal-boats for a moderate distance, by tracking or by sails; so that the whole of the lower stations upon the several rivers could be supplied with English

Mode of supplying the Steamers with coal.

Probable profits of the undertaking.

coal at a moderate rate of charge, while the upper stations, to which access from the sea is difficult, would be supplied from local sources, which the researches of the Coal Committee at Calcutta shew to be available in the several localities of which mention has been made.

PROFITS.

Messrs. Boulton and Watt's estimate for a Steam Vessel of the kind proposed is £35,000—a high price, as it appears to me, and upon which a material diminution in the subsequent vessels might be expected; but it may be safely reckoned that five Steamers, each capable of carrying 250 tons of cargo on one foot of water, at a speed of 15 miles an hour, could be set upon the Ganges, in complete working order, for £200,000. Supposing the capital originally raised to be £250,000, about £50,000 would be left available for floating capital, and for the acquisition of the registered invention; and it is necessary to ascertain what dividend five Steamers would pay upon £250,000, supposing one Steamer to be always laid up for repairs, or that each vessel makes ten voyages instead of twelve annually. The results of this investigation are embodied in the following estimate of profits;—with which I close these cursory observations.

JOHN BOURNE.

London, *May 26th*, 1849.

ESTIMATE OF PROFITS.

ANNUAL RECEIPTS AND EXPENSES OF FIVE STEAMERS ON THE GANGES BETWEEN CALCUTTA AND DELHI, SUPPOSING EACH VESSEL TO BE LAID UP TWO MONTHS ANNUALLY FOR REPAIRS, AND TO CARRY 50 TONS LESS THAN THE FULL CARGO.

RECEIPTS.	
200 Tons of Goods per voyage for 20 voyages by 5 vessels, at 1½*d.* per ton per mile of direct distance of 900 miles, instead of 2½*d.* per ton per mile at present charged	£112,500
300 Tons of goods per voyage, extra, during the rainy season, for 5 voyages by 5 vessels at 1½*d.* per ton per mile of direct distance of 900 miles, instead of 2½*d.* per ton per mile at present charged	42,187
12 Passengers per voyage for 20 voyages by 5 vessels, at 1*s.* each per mile of direct distance, being a less sum per mile than is at present charged	54,000
Freight of Treasure, intermediate Passengers, &c., not reckoned.	
	£208,687

EXPENSES.	
220 Tons of Coals per voyage for 20 voyages by 5 vessels, at 30*s.* per ton	£ 33,000
Extra coal during the rainy season, to meet the increased load of vessels	4,000
Wages of Captain, Engineers and Crew, Provisions, &c., for 5 vessels	17,500
Agents, Coolies, and Sundries	10,000
Management and General Charges	15,000
Repairs, or Wear and Tear, at 10 per Cent. on £200,000	20,000
Depreciation at 10 per Cent. on £200,000	20,000
Insurance at 7½ per Cent. on £200,000	15,000
Contingencies	10,187
Balance applicable to dividend, being £25 . 12*s.* per Cent. upon £250,000	64,000
	£208,687

POSTSCRIPT ON THE COLONIZATION OF CASHMERE.

Easily defensible, and with a congenial climate.

Though not falling strictly within the business of this report, I nevertheless take occasion to mention, that perhaps one of the main advantages of the establishment of Steam Navigation upon the Indus is the facility it would afford for colonizing Cashmere, and other contiguous districts in the hills, with an English population, holding their lands by a military tenure. Such a Colony would constitute a great fortress, that would overawe the whole of central Asia, and obviate the necessity of having so large a standing army in the Punjaub. And as the climate of Cashmere is one that would be congenial to the English constitution, and as Steam Navigation upon the Indus and Jailum would render the country easily approachable, it may be presumed that there would not be much difficulty in the establishment of a colony in the manner suggested. Cashmere is about 120 miles long and about 20 miles broad, and is encircled by a range of lofty mountains, through one of which the Jailum has worn a passage, and which chasm constitutes a pass or gate by which the valley is entered from the Punjaub. The population which, 25 years ago, was 800,000, is now only 200,000; and the oppression of the Sikhs, who conquered the country in 1819, has been such as to have nearly

extinguished trade of every kind. The natives of the country are a most ingenious people, but have lost their martial spirit during a long course of oppression; and there are large tracts of rich land which would be available for settlers, and for the produce of which a ready outlet would be afforded. Cashmere supplies the whole of India with saffron, and its attar of roses is much superior to the Persian, or to that of any other country. Rice is grown with great success, and also maize, gram, wheat, barley, and millet; and the whole of the fruits and vegetables usual in England are producible in great perfection. The country is also favourable to the production of silk. The shawls of Cashmere find their way into all countries, and fire-arms and cutlery of a most perfect description are made by the native artisans. The paper of Cashmere is finer than that made in India; the lacquered ware is highly valued; and the productions of the lapidaries in rock crystal and chalcedony display much taste and skill. Whether as regards the salubrity of its climate, the fertility of its soil, the docile ingenuity of its inhabitants, or the strength of its position, Cashmere seems to be pointed out as an eligible site for a colony which would constitute a bulwark against the invasion of India from the North-West, and at the same time overawe India and the Punjaub by the spectacle of *a little England* on the frontier, following the ordinary avocations of peace, but prepared for war on any emergency.

Richness of the products of Cashmere.

Scheme of a military colony of English.

The most economical mode of establishing an English colony in the manner suggested would probably be, to recruit an army for India in England, on the understanding that, after a certain period of service, the whole army, both officers and men, should be settled in Cashmere, receiving each a tract of land on the condition that he and his descendants should be ready to do military service for it when required. It might be a further advantage if the persons thus settling were to form alliances with the Syah Posh, a people of the Hindoo Koosh inhabiting Kaffirstan, lying on the North of Cabool, and who are reputed to be the descendants of the Greeks settled at Bactra by Alexander. The Syah Posh are a fair and handsome people, and for ages have held their country, in spite of the combined machinations of the Mahometan nations around to dispossess them of it; and the alliance of this people would be tantamount to the establishment of another colony in the mountains north of Cabool, whereby the ultimate occupation of the valley of Cabool and of the Pass of Bamian would be facilitated, should that measure appear desirable at any future time.

It will be obvious to the most cursory observer, that while the establishment of Steam Navigation upon the Indus would facilitate the colonization of Cashmere and the Himalaya, the establishment of such colonies would, in return, necessarily augment the Indus trade: and it is only with reference to its operation upon the Indus trade that the question

has here to be considered. Apart, however, from the accession of trade due to this cause, the fact of establishing upon the Indus Steamers of the kind proposed would increase the demand of the Punjaub for such articles as woollen cloths, locks, hinges and screws, and copper, lead, and other metals. It does not appear probable that the cotton fabrics of that country would be supplanted immediately by those of England, which, though finer, are not so thick or so well adapted to a climate which, in winter, is exceedingly cold.

Accessibility of the country secured by appropriate Steam Navigation.

J. BOURNE.

Messrs. BOULTON *and* WATT.

London, April 25th, 1849.

DEAR SIRS—With reference to the drawings and specification of a new kind of Steam Boat for navigating shallow and shifting rivers, which I have had the pleasure of submitting to you, I have now to request that you will furnish me with an estimate of the amount for which you would undertake to construct such a vessel, complete in all her appointments, and the time within which you would engage to have her ready for trial in this country.

The contractors will be required to engage that the vessel shall be able to carry a load of 250 tons, either as troops or cargo, on a draft of one foot of water; and shall be able to run in still water at the rate of 15 miles an hour, and to have the wheel apparatus sufficiently strong and powerful to enable the vessel to surmount shoals in the river, where such occur, in order that the voyage may be pursued without interruption.

As builders of the hull of the vessel, a work you state not falling within your business, I have to suggest that you should select some person in whom you can place entire confidence; as it is reckoned desirable, with the view of obviating disputes, that there should be but one contract for both ship and engines: and it would be necessary, therefore, either that the shipbuilder should be a party to the general contract, or that the hull and fittings should be sub-let to him.

If you feel disposed to estimate for this vessel, it is important that I should have your offer within a week.

I am, DEAR SIRS,

Yours truly,

J. ROBERT.

J. Bourne, Esq.

London, May 7, 1849.

Dear Sir—Since the receipt of your letter of the 25th of April, and of the drawings and specification which accompanied it, we have given our best attention and consideration to the important question to which those documents relate. The advantages to be gained by surmounting the obstacles which at present interfere with the navigation of Indian rivers are obvious; and we are of opinion that the two principal difficulties, arising from the strength of the current and the shallowness of the water, may be effectually surmounted by the species of vessel you have proposed for that purpose. We believe that, by the adoption of such a vessel, an immense extent of inland navigation may be beneficially opened; and that rivers, of which the depth does not much exceed one foot, and with the current running in parts at the rate of 8 or 10 miles an hour, would be navigable under the proposed arrangement.

We think the engines, which are high pressure, should be capable of exerting from 300 to 350 actual or indicator horses' power; and we believe that, with this power, the composite vessel would be propelled at the rate of 15 miles an hour carrying a load of 250 tons, either in the shape of troops or merchandise, upon a draft of 12 inches of water.

This opinion is founded on the results of long experience with vessels of various forms and of different degrees of power; and although in this case there is much novelty, and the amount of surface friction is unusually large, still we consider, that in anticipating a speed of 15 miles an hour from the power we have mentioned, we have left an ample margin for these contingencies. We also feel no difficulty in undertaking to construct a vessel on the plan you have prescribed, capable of carrying a load of 250 tons upon 12 inches draft of water.

With reference to the arrangement of wheelwork for carrying the vessel over shoals in the river, the wheels may certainly be made of sufficient strength to sustain a large part of the weight of the vessel; and we are of opinion that, by the use of such wheels, important facilities for getting off or over banks or shoals will be acquired. Rivers, however, with less than 12 inches of general depth of water should, in our judgment, be considered not navigable; for however useful the wheels might be in surmounting occasional shoals, we apprehend they would be taxed too largely if employed to force the vessel over considerable distances in which there was scarcely any water. We understand your proposal, however, to be, to use the wheels in an auxiliary manner for helping the vessel over sand-banks, or to enable her to regain the navigable channel when she happens to have deviated from it; and for such occasional or incidental uses, the wheels you propose appear to us likely to be of great service.

It is very difficult to form a correct estimate of the cost of vessels and machinery in which there is so much variation from ordinary practice. We have endeavoured to arrive at the cost as nearly as we can; and we find that the price of the composite boat, consisting of several vessels, as shewn in your drawing and specification, constructed in the manner detailed therein, and fitted up with cabins, deck-houses, and all necessaries, (excepting moveable furniture, steward's and other stores,) together with engines capable of exerting from 300 to 350 horses' (actual) power, and the machinery for assisting the vessel off the shoals, will be £35,000; (say Thirty-five thousand pounds). This sum includes putting the boats and machinery together, and trying them on the River Thames, and subsequently taking them to pieces, and delivering all the parts, ready packed for shipment, alongside vessels in the port of London.

We think some alterations in the description of materials

may be beneficially made, which would considerably reduce the cost, without detracting from the durability, strength, or efficiency of the vessels; and if it should not be thought necessary to have the hoisting apparatus for the paddle-wheels, which we also think might be dispensed with, a reduction would be made of £1000.

Payments to be made in cash, either in four or five instalments; the first to be paid on signing the contract, and the last when the whole is completed ready for delivery in the docks. With reference to the paragraph in the specification relating to the security to be given by the contractor for the due performance of the work, we cannot give any other than that which attaches itself to the credit our house has hitherto enjoyed, and which has been found sufficient with all parties and governments, at home and abroad.

The time in which we will undertake to have the boats completed and tried on the Thames is nine months from the date of the order; but we object to become liable to a penalty, unless accompanied by the condition of our receiving a premium, for each week we may be ready before the stipulated time, of an equal amount to the proposed penalty for default of time.

We remain, Sir,

Your obedient Servants,

James Watt & Co.

APPENDIX.

CONTAINING EXTRACTS FROM OFFICIAL AND OTHER DOCUMENTS RESPECTING THE PECULIAR FEATURES OF THE NAVIGATION OF THE RIVERS OF INDIA.

JUMNA, GANGES, AND BHAUGIRUTTEE.

Jumna.—"In Davidson's travels in Upper India it is stated that Mr. Davidson crossed the Jumna 20 miles below Padshomupal; and, though the waters are divided between the Doab Canal and the Ferozeshah Canal, that the main stream in the dry season (April 17th) is 300 yards wide, and deep, with a strong current. Mr. Prinsep speaks of works having been carried on to improve the navigation *above* Delhi. Mr. Thornton's MSS. E. I. Co.

Measures are said to be in progress for constructing a Canal from the Jumna, 5 miles east of Karnal, to the Sutledge at Loodiana, for irrigation."

Report of Captain Smith's operations on the Jumna in 1831–1832; with a Letter from Major Irvine to Captain Young, Secretary of the Military Board, June 24, 1833.—"All the most dangerous rocks have been removed. The pass at Kurrim Khan is now safe and easy; and boats, instead of being detained six or seven days, proceed as easily as anywhere else." E. I. Co.'s MSS.

Captain Smith's report of the operations on the Jumna speaks of a shoal having been overlooked, with only 2 feet of water, and of orders given to deepen it. He speaks also of a rock existing between Agra and Allahabad, with only 1¼ to 2 feet of water, on which a buoy was to be fixed.

E. I. Co.'s Maps. The narrowest part of the Jumna, between Delhi and Tuppul, measures from 300 to 400 yards, and the sharpest curve has 800 yards radius, with a width of river at that point of 500 yards.

Between Tuppul and Futtehabad the narrowest part measures from 200 to 220 yards, and the sharpest curve has 400 yards radius, with a width of river at that point of 200 yards.

Between Futtehabad and Kalpy the narrowest part measures from 180 to 200 yards, and the sharpest curve of the inner bank has 250 yards radius, with a width of river at that point of 200 yards.

Major W. E. Baker. (Private.) Major Baker states, in a Letter received from Luntwardine, dated March 20, 1849—"From what I have heard, I am inclined to believe, that between Agra and Delhi the stream of the Jumna, at no place and during no season, has a less depth than from 1 foot 6 inches to 2 feet. Between Delhi and Kurnal (that is, *above* Delhi) there are places, I believe, where the depth is sometimes reduced to about 1 foot."

Albert Robinson, 1848, p.12. *Ganges.*—"The Ganges, when low, is ¼ of a mile to 1¼ miles (wide); when high, from 1 to 3 miles. The depth of the Ganges, when high, is, in the channels, between 35 and 75 feet, and, when low, between 3½ and 10 feet. The perpendicular rise of the river in the wet season, at Jellinghee, is about 32 feet.

Page 16. For the greater part of the low water, or dry season, the Ganges is not navigable for vessels of much draught; as although, in many intermediate distances between towns upon its banks, there is ample depth of water, it is of course necessary, in the *thorough* navigation, that the vessel should pass over all the shoals and sand-banks: upon many of them the depth, as before stated, varies from only 3½ to 5 feet, and, in a particularly dry season, during April and May it may be found even under 3 feet.

Page 17. During the period of high-water, or inundation, already

mentioned, the navigation presents few difficulties, beyond the force of the current, to vessels ascending the river, which now averages a velocity of 4 miles an hour for the whole distance, and is frequently met running at 6 or 7 miles per hour, while at a few points, its velocity reaches 8 miles an hour.

The velocity of the current of the Ganges is less at this period (the dry season) than during the rainy season, the average between Allahabad and Rajmahal probably not exceeding 2½ miles per hour." Page 17.

"During August, and part of September, the level of the water decreases 3 inches to 4 inches daily; during part of September to the end of November it decreases daily 3 inches to 1½ inch; and from November to April it decreases daily ½ an inch." Major J. Rennell, 1788.

	Velocity of river in feet per hour.	Breadth of river in feet.	Quantity of water discharged in feet per second.
Rainy Season,	23,800	2080	494,208
Winter	7435	1780	71,200
Dry Season .	4425	1730	36,330

Asiatic Journal.

Captain Colebrooke remarks, that the mere operation of dragging a boat through any of the shallows tended, by stirring up the sand, to deepen the channel.

The Bhaugiruttee.—The narrowest part of the Bhaugiruttee measures 200 yards. Major J. Rennell's Maps, 1788

"The Bhaugiruttee, though called a river, is a side channel, or mouth of the Ganges, and through which the navigation is performed in the high-water season: the width varies from a furlong to a quarter of a mile." Albert Robinson, 1818, p. 12.

EXTRACTED FR

SMALLEST DEPTH OF WATER IN THE BHAUGIRUTTEE, I

DA[illegible] O

Localities.	Jan. 8.	May 15.	Jan. 23.	Jan. 31.	Feb. 7.	Feb. 14.	Feb. 21.	Feb. 29.	Mar. 8.	Mar. 15.
BHAUGIRUTTEE RIVER:										
At Entrance	6.0	6.0	6.0	6.0	6.0	6.0	5.9	4.6	4.3	4.6
Below Entrance ..	4.6	4.6	4.6	4.6	4.0	3.9	3.9	3.3	3.0	3.3
At Pankah	....	....	....	3.4	2.7	2.7	2.6	2.7	2.6	2.10
At Sauspore	3.6	3.9	3.0	3.0	....	....	....	....	....	2.3
At Radharghaut ..	....	3.3	....	....	....	2.9	3.0	2.9	2.8	2.6
At Koomapore....	....	....	....	....	2.6	....	2.9	2.9	2.8	2.6
Above Mirzapore..	2.6	2.9	3.0	4.0	2.6	2.9	....	2.0	2.3	3.5
At Nuddea.....	4.0	2.9	2.8	2.8	2.8	3.4	3.0	2.6	2.6	2.6
JELLINGHEE RIVER:										
At Entrance	5.4	5.0	4.9	4.5	4.5	4.0	3.9	4.0	3.10	3.6
At Gopalpoor	....	....	....	....	....	3.2	3.0	2.9	2.9	2.8
At Ootumpoor ...	3.8	3.4	3.4	3.0	2.10	....	2.8	2.8	2.8	2.8 to 2.3
At Depenpoor	3.10	3.9	3.4	3.6	3.4	3.6	3.6	to 3.6	3.6	3.6
MATTABANGHA RIVER:										
At Entrance	5.4	5.6	4.9	4.5 to 0.3	2.5	3.5	3.5	3.0	3.0	2.9
At Lasoctuttah ...	4.0	3.6	2.0	2.0 to 0.8	1.11	1.10	1.8	1.8	1.8	1.8
At Doorgahpoor ..	1.0 to 2.8	2.1	1.10	1.8	0.0	0.0	0.0	0.0	0.0	3.0
At Koondieemorall	3.4	3.6	3.4	3.0	3.0	2.10	1.10 to 2.9	1.1	1.1	2.10

ENGLISHMAN" OF 1848.

JELLINGHEE, AND IN THE MATTABANGHA RIVERS.

VATION.

Mar. 25 & 31.	April 8.	April 15	April 22	April 30	May 8.	May 15.	May 23.	May 31.	June 8.	June 16.	June 22.	
{4.0 / 4.0}	4.0	4.6	6.0	6.0	6.0	6.0	7.0	7.6	8.0	9.0	10.0	
{3.0 / 3.0}	3.0	4.0	5.0	4.0	4.0	4.0	6.0	6.0	6.0	6.0	7.0	
{2.0 / 2.9}	2.7	2 10	....	....	....	....	....	....	....	....	....	
2.3	....	2.3	2.9	2.7	2.6	2.6	3.9	....	....	....	5.3	
{2.5 / 2.3}	2.3	2.3	2.9	2.10	2.9	2.7	....	3.3	3.8	4.0	....	
{2.4 / 2.4}	2.2	2.3	2.9	....	2.9	....	2.9	....	....	....	....	
3.5	2.7	2.0	2.3	2.6	2.2	2.8	....	....	3.3	....	5.0	
{2 6 / 2.6}	2.0	2.0	2.0	2.0	2.0	2.0	2.2	3.10	3.10	5.10	6.0	
{3.3 / 3.2}	3.2	3.5	3.9	3.10	3.4	4.0	5.0	6.0	6.3	6.9	8.9	
3.0	....	2.7	3.0	....	....	2.11	....	....	....	....	....	
{2.7 / 2.8 / 2.10}	2.7	2.4	2.10	2.10	2.8	2.9	3.5	4.2	4.3	3.9	4.9	
{3.2 / 3.0}	3.0	3.6	3.0	3.0	3.4	3.0	3.0	3.6	3.8	4.4	5.6	
{2.9 / 2 4}	2.4	2.4	2.6	2.6	2.6	2.7	3.2	3.10	3.9	4.3	6.9 / 4.4	
{1.7 / 1.5 / 0.0}	1.5	1.3	1 8	1.7	1.6	1.7	2.4	3.5	3.8	3.6	1.0	
2.10 / 2.8	0.0	0.0	0.0	0.0	0 0	0.0	0.0	0.0	0.0 / 2.11	0 0	1.0	
2.9	2.10	2.10	2.10	2.9	2.9	2.11	3.2	3.8	3.10	4.4	4.8	

RAINY SEASON COMMENCES.

(Signed by) Capt. I. LANG,
Official Superintendant of Nudden Rivers. 1848.

Distances.

Distance from Calcutta to Allahabad by the Bhaugiruttee		787 miles.
Distance from Calcutta to Allahabad by the Sunderbunds		1147 ..
Distance from Allahabad to Delhi by the river	about	600 ..
Distance from Calcutta to Allahabad by the road	498	
Distance from Allahabad to Delhi by the road	402	900 ..

Traffic of the Ganges.

Albert Robinson, 1848, pp. 18, 19.

"The Returns from the Government Inland Steam Department in the year 1844 gave 39 voyages, carrying 45,500 packages of goods, besides treasure, and 2500 passengers, and shew a return of upward of £56,000.

From Mirzapore, a great mart on the Ganges, it is reckoned that 18,000 tons of cotton, 200 tons of sugar, 1000 tons of saltpetre, 1500 tons of indigo and lac-dye, are annually sent down to Calcutta; whilst there is received at Mirzapore from Calcutta, yearly, 8000 tons of metal and hardware, 5000 bales of twist, 3000 packages of British silk and cotton goods, and 10,000 packages of other piece-goods. The far greater part of the enormous traffic on the Ganges is carried on by means of the native craft."

Indian Railways by an old Indian Postmaster, pp. (Appendix) xvi. xvii.

Total Traffic on the Jumna downwards, taken at Allahabad Bridge of Boats, during 25 days of April 1841.

			tons	tons.
36,024 bags of Salt	at	12 bgs. per ton,	3002	
52,080 bales of Cotton		8	6510	
828 bags of Saltpetre		12	69	
2000 Hides		50 ..	40	
Add for 5 days			1924	
				11,545

Jumna Traffic upwards.

			tons	tons
		Brought forward.....		11,545
13,119 bags of Rice.....	at 12 bgs. per ton,		1193	
2240 ditto Cocoa-nuts.....	12		170	
2347 ditto Spices.....	12		195	
2815 Miscellaneous.....	12		234	
	Add for 5 days.....		358	
			——	2150
				13,695

Total Traffic on Ganges downwards, as taken at Allahabad Bridge of Boats in April 1841.

54,700 pieces of Kurwah Cloth, at	500 ps. per ton,		109	
1004 bags of Mustard.....	12		84	
6305 ditto Saltpetre.....	12		525	
7162 bales of Cotton.....	8		895	
12,250 Hides.....	120		102	
4450 Miscellaneous.....	12		371	
13,700 Horns.....	120		114	
			——	2200

Ganges Traffic upwards.

1348 Wine Chests	..at 12 per ton		112	
1013 bags of Cocoa-nuts... ..	12 bgs. per ton,		84	
7394 ditto Rice.....	12		616	
4189 ditto Spice	12		349	
4940 Iron and Tin	10		494	
			——	1655
In addition to this, 94 boats, containing passengers and goods not counted, and which may be estimated at 40 tons each				3760
Total amount of Traffic on the Ganges and Jumna in April 1841.....				21,310

Statement of the amount of Traffic along the Grand Trunk Road, as kept at Futtehpore, under the superintendence of Conductor Tuceffe, during the month of April 1841.

Futtehpore, May 1, 1841.

	Hackeries.*	Bullies.†	Camels.	Elephants.	Bullocks.	Tattoos.‡	Mules.	Horses.	Buggies.	Carriages.	Palanquins.
West	636	407	64	23	106	162	54	19	8	2	48
East	441	428	159	21	189	133	7	19	5	3	55
Day	1077	835	223	44	295	295	61	38	13	5	103
Night	419	113	197	6	50	33	..	72	19	..	58
Total	1496	948	420	50	345	328	61	110	32	5	161

* Native carts. † Native carriages. ‡ Ponies.

Railways in India, by John Bourne, C.E., p. 34.

"In the Report of the Rajmahal Canal Committee, drawn up in 1841 by officers of the Government, it is stated, at page 25, in reference to the trade upon the Ganges, that in the dry season, when two of the Nuddea rivers (which are branches of the Ganges) were only passable for dinghees, the smallest description of country boat, and the third only navigable for the minor class of cargo boats, the annual collection of toll, which is charged at the rate of one rupee per 100 maunds, amounted to 150,000 rupees; which gives a tonnage passing through the Nuddea rivers of 1623 tons per day, or 592,600 tons per annum. As this, however, is not the total tonnage, even in the dry season, and as the tonnage in the dry season is not the average tonnage, the Committee consider that if the Rajmahal Canal were made, the amount of tonnage passing through it, from the Ganges to Calcutta, would not fall short of 3000 tons per day, or 1,095,000 tons per annum.

The results obtained from other sources add weight to these deductions. It appears from the official statement of the collector of the tolls at Jungpore, on the Bhaugirutee

river, that in the year 1844-45 the following boats passed through that branch of the Ganges:—

1113 Boats laden with Firewood, Straw, Coals, &c., tonnage in maunds.....	10,68,050
7,311 Boats laden with Grain, Vegetables, Indigo, Seed, and Mangoes	40,29,675
24,329 Boats laden with Salt, Sugar, Saltpetre, Cotton, Indigo, &c.....	1,64,00,025
Total tonnage in maunds.....	2,14,97,750

or taking 27 maunds to the ton, the tonnage of the laden cargo boats which passed through the Bhaugiruttee in 1844-45 was 796,213 tons. Between 5000 and 6000 empty boats also passed during the same time, but they need not be taken into account. To catch the vessels coming through the rivers of the Sunderbunds, a toll is imposed on the vessels navigating Tolly's Nullah and the Circular Canal at Calcutta. This toll is charged at the rate of 8 annas, or $\frac{1}{2}$ rupee, for every 100 maunds of tonnage, boats of less than 100 maunds not being counted; and in the years 1844-45 it yielded 177,791 rupees, shewing that 35,558,200 maunds of tonnage had passed through it, which, at the rate of 27 maunds to the ton, is 1,316,970 tons; and adding this to that which passed through the Bhaugiruttee, we have 2,113,183 tons for the yearly traffic on the Ganges. From this, however, several deductions are to be made. The boats are for the most part without decks, and cannot with safety be laden to the extent of their register tonnage: some of the articles of transport come from places so low down upon the Ganges, that they could not be available to swell the traffic to Mirzapore; while others, it may be supposed, come from places which are not on the Ganges at all, though the number of such cannot be considerable. It appears, from the statement of M. Larruleta, the toll-collector at Jungypore, given in Mr. Stephenson's second Report,

(p. 34), that boats do not carry, on the average, more than two-thirds of their register tonnage; and two-thirds of 2,113,183 are 1,408,789 tons. Deducting from this one-fourth for the local trade of the Sunderbunds, we have 1,056,592 tons per annum as the Ganges traffic, independent of the Steamers, or 1,059,294 in all; instead of 1,095,000 tons as estimated by the Rajamahal Committee. In the Returns from which this estimate is derived, the opium passing down the Ganges from Patna and Benares, and the ammunition, provisions, &c., transmitted for the use of troops, are not included, as no toll is exacted for the conveyance of those articles, and there is, therefore, no ready means of ascertaining their amount.

It appears from the Returns of the Jungypore toll-office for the years 1840-41, given in Mr. R. M. Stephenson's Report on Indian Railways (p. 71,72), that the number of passengers proceeding from Benares and other places above that city to Calcutta, by way of the Ganges and Bhaugiruttee, was 26,428 per annum; and that the number of passengers proceeding from Calcutta to Benares and other places above that city, by the way of the Bhaugiruttee and Ganges, was 31,950; making a total number of passengers of 58,378 per annum. This return, however, cannot be expected to give all the passengers travelling on the Ganges, as some of these passengers in the deeper boats may be expected to have been conveyed by the Sunderbunds; but the number of passengers proceeding in country boats by this route cannot be considerable, and as we have no official return of the number, the allowance to be made for them must be a small one. Bearing in mind, however, the probable increase between 1840 and 1845 upon the general Ganges traffic, as well as reckoning the number of passengers who proceed from the Ganges to Calcutta in country boats otherwise than through the Bhaugiruttee, we shall be within the truth if we take the number of passengers between Benares

or Mirzapore and Calcutta, who travel by the Ganges, as 60,000 in 1845, instead of 58,371, as ascertained by the toll-collector on the Bhaugiruttee to have passed through that river alone in 1840-41.

It appears, from a statement of the quantity of freight and passengers carried in the Government iron Steamers plying on the Ganges between Calcutta and Allahabad, given in Mr. Stephenson's Report on Indian Railways (p. 63), that in 1840-41 those vessels carried upwards, to places on the Ganges, of which none were lower than Patna, 57,160 cubic feet of cargo, besides 393,179 pounds weight.

The treasure carried upwards, during this same period, amounted to 11,034,198 Rs., or £1,103,419; and downwards, to 800,375 rs., or £80,037. The passengers carried upwards were 302; downwards, 151. A subsequent return for the year 1841-45, printed in Mr. Stephenson's Second Report (p. 37), shews a great increase. In that year 7 vessels performed 39 trips upwards to Allahabad, carrying 1673 passengers, 112,765 measured feet of cargo, 1,156,909lbs. weight of cargo, and 17,588,855 Rs., or £1,758,885 in specie. The return voyages were not nearly so productive. About half the number of passengers appear to have been carried downwards by the Steamers that were carried upwards, and less than half the cargo and specie. The number of downward trips made in the year, and the total revenue from them, are not given in the Return from which we have quoted; but the number of downward trips must of course have been about the same as the number of upward trips; and, from the Returns of several downward trips which are given, the proportion of goods and passengers carried downwards appears to be what we have stated. Taking the downward goods and passengers at one-third of the upward goods and passengers, we have 2231 for the total passengers, 150,353 for the total feet of

goods, and 1,542,545 for the total pounds weight of such goods as are estimated by weight, as the returns of the traffic maintained by the Steamers on the Ganges. A cubic foot of goods is reckoned as weighing 30lbs. The total weight of the goods conveyed in the Steamers will therefore be 2702 tons 6 cwt.

SUMMARY.

Traffic, per annum, reckoned both ways, between Calcutta and Mirzapore, by the River.

Merchandize.

Carried by the river in native boats.....	1,056,592 tons.
Carried by the river in Steamers	2702 ..
	1,059,294 ..

Traffic by the road:

Carried at present by the road and Damooda, 106,754 tons.

Passengers.

Carried by the Ganges in native boats.....	60,000
Carried by the Ganges in Steamers.....	2231
	62,231
Travellers by the road	507,453

Traffic per annum, reckoned both ways, between Mirzapore and Delhi.

Merchandize.

Carried by river and road, export, import, and local, 879,190 tons.

Passengers.

Total passengers by the road 446,851

It appears that the cost of carrying goods up the Ganges from Calcutta to Mirzapore is 0·91*d.*, or very nearly 1*d.* per ton per mile; while the cost of carrying goods downwards is 0·54*d.*, or little more than ½*d.* per ton per mile; or, with insurance, it is 0·72*d.*, or nearly ¾*d.* per ton per mile. Taking

the cost of transport at ½*d.*, and the insurance at ¼*d.* per ton per mile, and reckoning that the interest of the money is 10 per cent., the value of the goods £40 per ton, and the length of the time occupied in the transport between two and three months, we shall have to add 0·43*d.* per ton per mile for interest, which makes the cost of the carriage downwards 1·15*d.*, or rather more than 1*d.*: the cost of the carriage upwards 1·59*d.* and the average 1·37*d.*, or very nearly 1½*d.* per ton per mile.

Cost of Ganges conveyance by native boats.

	Cost per ton per mile.
Average upwards, including interest and insurance (time 2 to 3 months)	1·59*d.*
Average downwards	1·15*d.*

Cost of transport by the river, in Steam Vessels.

Average upwards (time 24 or 25 days)	4*d.*
Average downwards	1*d.*

Passengers.

	Cost of each Passenger per mile.
Expense by land, per palanquin	8*d.*
Expense by horse, &c.	1·12*d.*
Expense by native boat, *including subsistence* (time 38 days)	0·6*d.*
Expense by foot, *including time and subsistence*	0·533*d.*"

" There are 3 classes of cabins for the accommodation of passengers in the accommodation boats; and in the Steamers, troop-boats, and cargo boats, cabins are also available. The charges are, for the cabins of the first class, 6 annas; for the second, 5; and for the third, 4 annas per mile, or for the passage to Allahabad Bengal Almanac for 1845

	Co. Rs.	Of direct distance
1st class cabins	300 (or	1*s.* 2½*d.* per mile)
2d class cabins	250 (or	1*s.*)
3d class cabins	200 (or	9*d.*)
A deck passage ¼ an anna per mile	(or	1*d.*)

104872

Freight on all packages, excepting treasure laden in Calcutta, or for which tonnage is reserved in Calcutta, and which does not exceed in weight 35 lbs., or 17½ seers per cubic foot, will be charged by the cubic foot. Packages exceeding 35lbs. will be charged by the weight,

From Calcutta

	Per foot.	Per lb.	Per seer.
To Bhagulpore,	0 rs. 12 as. (1*s.* 6*d.*)	5 pie (½*d.*)	10 pie (1¼*d.*)
To Dinapore	1 .. 0 .. (2*s.*)	6 pie (¾*d.*)	1 an. (1½*d.*)
To Allahabad...	1 .. 4 .. (2*s.* 6*d.*)	8 pie (1*d.*)	1 a. 4 pie (2*d.*)

The charge for freight from Allahabad to Calcutta is fixed at one-sixth of that from Calcutta to Allahabad; and in consideration of this very low rate, and of the demand at stations above Dinapore exceeding the capacity of all the boats, this charge will be the same from all stations, viz. 1 anna (1½*d.*) per 9 lb. weight, or 3 annas 4 pie (5*d.*) per foot, with the exception of cotton in half-screwed bales of about 26 feet, not exceeding a gross weight of 300 lbs., for which the charge is 2 rs. 10 annas (3*s.* 3*d.*) Sugar, hides, horns, and tallow, are excluded from the accommodation and troop boats, but from them only.

Goods carried intermediately are charged as follows, both upwards and downwards; viz.,

	Per cube foot.	Per lb.
Moorshedabad, or Bhagulpore & Monghir,	4 as. (6*d.*)	or 2 pie (¼*d.*)
Monghir and Dinapore	4 as. (6*d.*)	or 2 pie (¼*d.*)
Dinapore and Benares	4 as. (6*d.*)	or 2 pie (¼*d.*)
Benares and Allahabad	4 as. (6*d.*)	or 2 pie (¼*d.*)

And no package, however small, is conveyed for a less charge than 1 rupee 8 annas (3*s.*), either upward or downward.

Freight on Treasure.

Calcutta and Allahabad	12 as. per cent.		(1*s.* 6*d.*)
.... and Mirzapore	10	.....	(1*s.* 3*d.*)
.... and Benares	8	.....	(1*s.*)
.... and Dinapore.....	6	.....	(9*d.*)
.... and Monghir	5	.....	(7½*d.*)
.... and Moorshedabad .	4	.....	(6*d.*)
.... and Commercolly ..	4	.....	(6*d.*)
Allahabad and Mirzapore	2	.....	(3*d.*)
.... and Benares	4	.....	(6*d.*)
.... and Dinapore	6	.....	(9*d.*)
.... and Monghir	8	.....	(1*s.*)
.... and Moorshedabad .	10	.....	(1*s.* 3*d.*)
.... and Commercolly ..	10	.....	(1*s.* 3*d.*)

Freight on copper coins is charged by the weight, at 8 pie (1*d.*) per lb., from Calcutta, and down and intermediately, the same as on weightable goods."

THE GODAVERY.

E. I. Co.'s MSS.

Second Report of Major Cotton for improving the irrigation of the Rajamundry district, dated April 17, 1845.—Par. 2.—"The Godavery, rising near Bombay, passes for several hundred miles through an open country, watered chiefly by the S.W. monsoon: 200 miles from the sea it enters the hill-tract: 60 miles from this it enters the alluvial country. It has no falls in passing through the hills, nor throughout its entire length of channel; nor, indeed, any obstructions of consequence. Such is the statement of the boatmen, and confirmed by fact. The timber-rafts never come until the water is at its lowest, and has not more than 2 or 3 feet of water at the fords in the low country."

Par. 3.—"Within the line of the hills the river has, I conclude from the above-mentioned fact, a very moderate fall." Par. 10.—"The annicut proposed will close up two-sevenths of the whole water-way of the river

in floods. The velocity of the current is 3½ miles an hour." Par. 13.—"The annicut will obstruct the navigation in low freshes. This difficulty is provided for by navigable irrigating channels, and by locks."

Capt. Orr, in a Letter dated Sept. 16, 1848, says: "The locks are so proposed as not to interfere with the navigation."

A. Lawe, chief-engineer at Fort St. George, in a Letter dated March 31, 1846, says, (p. 221,) that "the waters never fail in the river."

E. I. Co.'s MSS. Capt. R. H. Fenwick, in a Letter dated Ajunta, Dec. 15, 1826, says, "That the navigation of the Wurdah from Woonee to Kalisir, and of the Godavery from Elgurp, near Neermul, to the coast is practicable, there remains no longer any doubt." During five or six years only one accident occurred.

E. I. Co.'s MSS. H. Chamier, Esq., Secretary to the Government of Madras, to G. A. Bushby, Esq., Secretary to the Government of India, dated August 28, 1810. Par. 2.—"Capt. Fenwick, in par. 10 of his Letter, states that he considers the Godavery and Wurdah rivers navigable for mercantile purposes, and offering a more advantageous mode of conveying cotton from Berar and the Nagpoor territories to the eastern coast, than on carts or bullocks by land: that Mr. Palmer came down from Chandah to Mahadenpoor in 18 hours; and he himself made the voyage from that place to Rajamundry in 52 hours; and adds, that he sent down cotton in flat-bottomed boats from Woonee or Onee, on the Wurdah, to the coast—the smallest boat being 30 feet by 10 feet, and the largest 48 feet by 18 feet, with 5 feet wall-sides; and the smallest boat came up half laden." Par. 3.—"It appears, therefore, probable, that Steamers like those on the Ganges might ascend the Godavery to a considerable distance, and afford great and important advantage, not only to trade, but especially for the conveyance of troops and stores for Nagpore and Jubbulpore."

In 1838, 6000 carts of cotton, &c., containing 160 lbs. weight, passed from Oomrowty through Jubbulpore to Mirzapore. Cotton Reports.

THE NERBUDDA.

"This river, during its progress, is much obstructed by rocks, islands, shallows, and rapids, which render its navigation in most parts difficult or impracticable, until it enters Gujerat, where it is navigable for small craft 11 miles above Tulluckwarra, above 100 miles from the sea. Above the Hernphal, or Deer's Leap, it is narrow and rapid; but it becomes again navigable about 15 miles below Chiculda, and, with the exception of a few places, continues so for some distance to the east of Hossingabad. At Sacur, to the west of Jubbulpoor, it is about 600 yards in breadth; at Mundelsir, 1200; and above and below Broach, where there are several islands, it expands sometimes to the breadth of 3 miles." Hamilton's E. I. Gazetteer, page 317.

Letter from Sir John Malcolm, to the Secretary of the Governor-General, dated Aug. 11. 1820. — Par. 3.— "Lieut. Hansard's and Matthew's surveys have established that, from the Hernphal, or Deer's Leap, to below the Mokree falls, a little above Tulluckwarra, the river is incapable of being rendered navigable." Par. 4.—"In April it is possible to go from Mundelsir to the Hernphal by small craft, and from Tulluckwarra to the sea with large vessels of 2400 maunds burden." Par. 6. —"Of the practicability of navigating that part of the Nerbudda, between Chiculdah and Mundelsir, during nine or ten months of the year, I have no doubt. Major Wilson says that the wind blows throughout this period from the westward, nearly increasing with the monsoon, and thus enabling the boats to stem the current, so as to come in one day from Chiculdah to Moheysir." Sir John Malcolm describes some vessels on the Nerbudda as of 10 to 50 E. I. Co.'s MSS.

Kulsies', or 8 to 40 Candies' burden, and that they draw 3½ to 5 feet water.—"As they ascend the river the boats are lightened. In the ordinary trade, toonies are used, which draw 3 feet water, and go to Mokree. They carry 8, 10, or 12 men. The current is 8 miles an hour. At the Mokree falls the boats are emptied, hauled up, and the goods carried by porters for about 1000 feet, and then reloaded. No boats have been lost. They go up to the Dharee falls; but the men are afraid of thieves. The boats are 22 feet by 4 feet 10 inches, and 2 feet deep, flat bottomed."

E. I. Co.'s MSS. Letter from Major Ouseley to F. C. Smith, Agent to the Governor-General, dated June 13, 1834. Par. 2.—"The possibility of making the whole river navigable exists, but the expense would be great. There is no place from Behragurha, near Jubbulpoor, to the mouth of the river, that cannot be rendered passable for such boats as are now used, namely, 30 to 40 feet long, 8 to 10 feet wide, and flat bottomed. All the rapids, excepting the Dharee falls, with trifling expense could be rendered passable, says the Surveyor. I am convinced nothing would improve Central India so much as water-carriage."

Note.—Major Ouseley, in the Letter, speaks of a channel not far from Hernphal not more than 10 yards wide.

E. I. Co.'s MSS. Letter from the Honourable Court of Directors, Marine Department, dated March 8, 1840, mentions a fall of 10 feet, and width of 10 feet; and says, "On reference to Capt. Ouseley's Report, however, we find it asserted that, with the exception of the Dharee falls, there is no place from Behragurha, near Jubbulpoor, to the mouth, that might not be rendered passable for such boats as are now used—30 to 40 feet long, and 8 to 10 feet wide. All rapids could, with trifling expense, be rendered navigable. Sir J. Malcolm cites Matthew's opinion in favour of the same objec- between Hernphal and Mokree; and we think that, whilst

the native Surveyor's opinion remains substantially uncontradicted, it ought to be further investigated."

Letter from C. Browne, Esq., P. Ass. Com. at Hossungabad, to C. Fraser, Esq., Nov. 20, 1840.—"The boats sent down the Nerbudda failed (in accomplishing the object). The men seem to have been frightened at the undertaking." E. I. Co.'s MSS.

Extract from Minutes of the Marine Consultation, Dec. 1840, contains orders to examine and report on the river, and capability of improvement. E. I. Co.'s MSS.

Report of Capt. Anderson, March 21, 1840 or 1841.—"From Mundelsir to Chiculdah, 51 miles, (the river is) navigable by boats, with the exception of the rapids at Sarsa Dharee, until the dry season. Luckily, however, there is a back stream, which might easily be made practicable throughout the year. Thus, to Chiculdah no obstacles particularly worthy of notice exist. The bed of the river is basalt; the banks are of marl on pebbles. (The pass at the Hernphal) is not so formidable as has been represented. We got down the canoe, but it was repeatedly upset. Ropes were attached to it." Suggests, that by locks 2 feet of water could always be secured; the locks to be open during the rainy season. E. I. Co.'s MSS.

G. A. Bushby, Esq.'s, Letter to J. Thomason, Esq., Jan. 6, 1841. Copy of Map forwarded.—"The obstacles to the navigation are delineated, and will satisfy his Honour the Governor-General of the utter impossibility of ever rendering the channel navigable upwards for Steamers, or even downwards for canoes or coal-rafts. At Dhardree it appears that there is a direct fall of 40 feet; and in the lower part of the river, where the stream crosses the Saltpoor range of mountains, there is, in one place, a shoot, stated to be only 10 feet wide, and the stream below this is so full of rocks and shoots, or falls, as to be totally unused for navigation." E. I. Co.'s MSS.

E. I. Co.'s MSS. Letter from W. H. Sleeman, Esq., to the Government Secretary of India, dated Feb. 12, 1841.

"From Hussingabad to Hindia, 52 miles proved by Lieut. Hore to be navigable by small boats during a part of the year.

"From Hindia to Dhardree . . 36 miles not navigable, but obstructed by rocks.

"From Dhardree to Mundelsir, 48 miles said to be navigable.

"From Mundelsir to Hernphal, 66 miles ascertained by Lieut. Matthews to be navigable in 1820.

"From Hernphal to Soolpan . . 60 miles navigable, excepting at two extremities.

"From Soolpan to Broach . . . 56 miles navigable."

Out of 318 miles, 222 navigable, 96 not navigable.

"True that the river must require some outlay to make it navigable, but the valley is rich in mineral and vegetable products, which await only the means of transit to make them available for natural wealth."

E. I. Co.'s MSS. Letter from J. Thomason, Esq. to G. Bushby, Esq., dated Feb. 12, 1841.—"The Native surveyor employed by Major Ouseley in 1834, was not capable of judging as to improvements of the river. He was of limited information, and had no experience; did not level the rapids nor examine the banks." Complains of the information procured not being sufficient to enable an opinion to be formed: requests that proper investigations may take place.

E. I. Co.'s MSS. Letter from Major J. H. Sandys (13 years Resident), dated Feb. 13, 1841.—"Were the river rendered navigable for Steamers, instead of a land-carriage from Bombay of 300 miles, most important results must ensue."

Letter from the Secretary of India to the Resident of Indore, dated March 15, 1841.—"The results of the various surveys unfortunately convince the Governor-General that no scheme hitherto suggested could be entered into with any prospect of success, and would only involve expenditure beyond any profit which could be expected: and, although any information cannot but be valuable, the Governor-General does not see any advantage from systematically repeating these inquiries." E. I. Co.'s MSS.

Dr. M'Clelland. Coal and Iron Committee papers, dated Dec. 2, 1843. Par. 2.—"The practicability of navigating the Nerbudda by flat-bottomed boats, from Chiculdah upwards to Hossungabad, appears to admit of no doubt. Par. 22.—Nor should we apprehend any deficiency of water, when Major Wilson found, even in the dry season, that flat-bottomed boats may ascend from Chiculdah upwards, a distance of 180 miles, only meeting with perhaps two places where porterage would be requisite for a few hundred yards." E. I. Co.'s MSS.

Captain Abbott's observations (without date). — "No obstruction exists to the navigation 100 miles from the mouth. The rocks at the Deer's Leap are divided at 16 feet distances. At the Hernphal the main channel is 40 yards wide. Twenty miles above the Dharee falls are navigable, excepting in the driest time." E. I. Co.'s MSS.

Captain Abbott proposes at Mokree a railway and incline.

. . . . . proposes at Hernphal the blasting of rocks for a few hundred yards.

. . . . . proposes at Dhardree a railway and incline.

. . . . proposes to level three abrupt declivities, and by dams to avoid 30 or 40 rapids.

These suggestions appear to be highly judicious, and would probably, if carried into execution, be successful in making the Nerbudda navigable at all seasons.

E. I. Co.'s MSS. Lieut.-Col. Wade's Letter to J. R. Davidson, Esq., Government Secretary of India, dated March 23, 1844.—"Captain Anderson's description of the obstructions on the Nerbudda, surveyed by him, and which I have personally visited, appear to me to conform more closely to their real nature than that of any other, excepting the assigning of 8 feet fall at the Sarsa Dharee falls, which do not, in my opinion, exceed 5 feet. And, with regard to the length of the Hernphal being considerable, I should say it cannot exceed 60 or 70 feet, and is composed of detached masses of rock, which I should say would easily yield to explosion. Captain Anderson justly remarks that the difficulties have been exaggerated."

Colonel Wade recommends blasting and inclines, but so as to preserve the water from running off too quickly. At present the rocks form deep pools of 15 or 16 miles long.

E. I. Co.'s MSS. Report of Lieut. H. L. Evans, and of Lieut. R. H. Keatinge, from Mr. R. Hamilton of Indore, dated July and August 1847. Par. 3.—"Above Mundelsir to Hossungabad there are two places where the passage of boats is obstructed." Par. 4.—"Above the Dharee falls to Chandghur, the natives informed Lieut. Keatinge that the river was navigable and open." Par. 7.—"Lieut. Keatinge made the trip from the Dharee falls to Mundelsir in March 1846, the river being open at that season, although the stream was then very shallow."

Par. 8.—"On the 22d of July, Lieut. H. L. Evans left Mundelsir and reached Chiculdah on the 24th, a distance of about 60 miles. At the Sarsa Dharee falls was the first obstruction, but this was avoided without material delay or difficulty, the boats going by the middle channel." Par. 9.—"Lieut. Edwards left Chiculdah on the 25th, and reached the Hernphal without meeting any sort of obstruction. At the Hernphal the river had risen 18 feet above the hot sea-

son water-mark, and Lieut. Edwards experienced very little difficulty in descending the rapid; but a mile beyond is the chief obstacle. The boats, however, were got down the southern channel with some difficulty. Two miles further on is the Gunnoll Ghaut, another rapid (of similar character); the fall, however, is inconsiderable, and the bed of the channel could be easily cleared and improved. Hence to Beytala, 20 miles, the passage is clear and deep." Par. 10.—"At Beytala is an obstruction very much resembling the Sarsa Dharee falls which Lieut. Edwards passed. Half a mile below Beytala is a very bad rapid, which was cleared by a channel under the north bank, down which the boats tracked. The river hence is deeper, very rapid, and free from material obstruction to Haump. Here the river narrows, and about 2 miles below Haump commences a series of rapids known as the 'Bhala Gori,' which continue for 4 miles: the river being much confined, rushes rapidly between high rocks, through which, with ordinary care, a large boat can be navigated. Lieut. Edwards' raft of canoes here got swamped, whilst the large flat-bottomed boat passed without trouble." Par. 11.—"Hence to Soolpan there is no difficulty. Six miles below Soolpan the Mokree falls are encountered: the river at its ordinary height in the rains (25 feet above hot season water-mark) covers the rapid, and the passage is safe. When the river is low (from 8 to 10 feet) there is a slack-water passage always available. From Mokree to Tulluckwarra the river is navigable and easy." Par. 12.—"From Tulluckwarra to Broach, boats of large size are constantly passing."

Par. 13.—"From the foregoing it is evident that Lieut. Edwards' trip has established, that a laden boat of moderate tonnage can be floated from the Dharee falls to the sea, without any considerable risk, during the rainy season."

Par. 15.—"The difficulties have been greatly exaggerated. Captain Anderson shot the Hernphal in March, at low water,

and he felt confident, as I (Lieut. Edwards) do, that the obstructions below the Hulnee river were not more insurmountable, even at that period, than those above, which had been, until his time, considered insurmountable even for empty boats."

Letter from Mr. Hamilton, dated 28th Feb. 1848, states "The Nerbudda is not navigable between Hindia and the falls of Dharee."

Conclusions drawn from the foregoing.—From the sea to Soolpan the navigation is open, and no obstruction occurs. At this place the Mokree falls, which are 6 feet high, occur, but there is a back channel which can be used. For a distance of 20 miles the channel is then disturbed with rocks.

Above Haump are the "Bhala Gori" rapids (marked on the plan 5 feet high). These, together with the two rapids close by, may be the three referred to by Captain Abbott, at which he proposes blasting: one can be avoided; and, with ordinary care, a large boat may be navigated through the Bhala Gori.

At the Hernphal the channel is 40 yards wide. At the Sarsa Dharee falls there exists a back channel which can be used. The Dharee falls are 40 feet high. The Mundhar falls are 10 feet high.

E. I. Co.'s MSS.

Traffic of the Nerbudda.

Dr. M'Clelland, December 2, 1813—"The connection of the Ganges with the western point of India, nearest to Europe, with the means of river navigation for nearly half the way, possesses at least the elements of a profitable line, having at one extremity three-fourths of the population and wealth of India, and at the other, the trade of the Persian Gulf and Arabia, and steam direct to Suez. The produce of Central India would necessarily pour into this, as the only channel by which it could find an outlet.

Cotton, hemp, oil, seeds, sugar, rice, shell lac, coffee, buffaloes' and stags' horns, ivory, hides, saltpetre, coal, and other produce from varied climates, and soil and mines of the Nagpoor, Saugor, and Nerbudda territories, for which there is now no outlet, would thus find a ready market; and large tracts, now waste, would be laid under cultivation and improvement. The same channel would return English piece-goods, woollen-cloths, hardware, and other manufactures, salt and dry-fish from the coast; and numerous articles, which constitute the trade with Arabia, would swell the commercial importance of the new channel." Capt. Abbott calculates the value of exports carried through Nimar to Bombay at 10,076,000 rupees per annum; and the imports through Bombay to Nimar at 973,800 rupees per annum."

Cotton of the Broach district exported annually is 7,056,000 lbs. At present the Oomrowty and Berar cotton goes to Bombay on oxen, costing 2*d.* per lb. in fine weather. General Briggs.

INDUS AND TRIBUTARIES.

"The Indus is navigable to Attock, the Jailum to Oin, the Chenaub to Aknur, the Ravee to Lahore, the Sutledge to Ropur. There does not appear to be any direct and certain information as to the extent of the navigation of the Beas; but as its volume of water is not inferior to that of the Sutledge, it may with probability be concluded that vessels can ascend nearly to its efflux from the base of the Himalaya, or for a distance of about 80 miles. Thornton's Gazetteer, page 125, Vol. II.

Indus from Attock to the sea is	942 miles.	Vol. I. page 60.
Jailum from the confluence with the Chenaub,	300 . .	Page 125.
Chenaub, as far as Aknur	300 . .	
Ravee, as far as Lahore	180 . .	
Beas	80 . .	
Sutledge to Ropur	380 . .	

Wood found the depth of the Indus at Attock in August Vol. I. page 269.

to be 60 feet, the rate of the current 6 miles an hour, and the breadth, when he measured it, 858 feet. About 10 miles below Attock the river, though in general rolling between high cliffs of slate-rock, has a calm, deep, and rapid current; but at Nile Ab it becomes an enormous torrent. At Ghoira the enormous body of water passes through a channel only 250 feet wide, but having a depth of 180 feet, the velocity being 10 miles an hour.* As the river approaches the plain country below Kala-Bagh the channel expands nearly to the breadth of 500 yards. Along the base of the Khussoree hills the channel is deep generally, having soundings about 60 feet. Between Mittun Kote and Bukkur the inundation extends sometimes 20 miles from the western side of the river in its low state, and 10 or 12 from the eastern side. Wood gives the width of the shrunken river as varying from 480 to 680 yards, its usual maxima of depth at 9, 12, or 15 feet, and its general velocity at 3 miles an hour; the three last items being very inconstant. Lower down, at Roree, the stream makes its way through a low ridge of limestone and flint. At Roree there are four rocky islets. From Sehwan downwards, to the efflux of the Fulailee, a distance of about 80 miles, the bed of the river is much depressed below the level of the adjacent country, and the banks are elevated from 16 to 20 feet above the surface in the low season. The Koree mouth may more properly be termed an arm of the sea, as the water is salt, and it receives a current from the Indus only during inundations of unusual height. Burnes found it 7 miles wide and 20 feet deep at Cotasir, about 20 miles from the sea.

Vol. I. page 271.

Vol. I. page 273.

Vol. I. p. 274-275.

Vol. I. page 278.

The tide influences the Indus nearly up to Tatta, a distance of about 70 miles. The spring tide rises 9 feet.'

* The proposed Steamer would ascend this rapid at the rate of 5 miles an hour, the velocity of the current having to be deducted from the velocity of the vessel through the water, to give the amount of her actual progress over the ground.

The Chenaub.—"At Akmur it becomes navigable, at least for timber rafts, which are despatched from it down the Punjaub. At Vozurabad, 70 miles lower down, Macartney measured it in July, when nearly at its fullest, and found it 1 mile, 3 furlongs, and 20 perches wide, with a depth of 14 feet, and a current running 5 miles an hour. From this point it holds a south-west course, for about 30 miles, to Ramnegurh, where, in the middle of February, and consequently the low season, it was found 300 yards wide, and with a depth of 9 feet when greatest, the current running 1½ mile an hour. It thence pursues a south-west course for about 150 miles to its confluence with the Jailum." At its confluence with the Ravee it was, at the end of June, the season of the greatest height of water, ¾ of a mile wide, and above 12 feet deep. Vol. I. page 138.

The Jailum.—"The river, on emerging from the mountains, is first navigable at Oin, and continues so to the Indus. At Jubalpoor, from which point Burnes descended by boat to Pind Dadun Khan, the stream is muddy, but rapid, with a current of 3 or 4 miles an hour. Elphinstone found it here, in July, 1 mile, 1 furlong, and 35 perches wide, with a depth of from 9 to 14 feet, and a current running 4 miles an hour. The Jailum was, at the confluence, when observed by Burnes at the end of June, about 500 yards wide. After the union, the channel of the united waters was a mile broad and 12 feet deep." Thornton's Gazetteer, Vol. I. page 291.

The Sutledge—"holds a very tortuous course, but in general west-south-west to Ropur, where it makes its way through the low sandstone ranges of Jhywan, and enters the plains of the Punjaub. It is here 30 feet deep, and more than 500 yards wide in its season of greatest fulness. Burnes crossed it in August, and found it, when fullest, 700 yards wide, with a depth, when greatest, of 18 feet, but on an average of only 12 feet. Up to this point it is navigable at all seasons for vessels of 10 or 12 tons burden." Thornton's Gazetteer, Vol. II. page 308

Traffic of the Indus generally.

Milburn's Oriental Commerce, 1813.

Value of merchandize imported from Cashmere into Bombay annually . . . . . 141,256 rupees.
Value exported to Cashmere . . . . . 78,254 . .

Thornton's Gazetteer, Vol. I. page 365.

"Hugel estimates the total value of the exports of Cashmere at £400,000, of which he apportions for woollens of all kinds £250,000, rice £100,000, other articles £50,000. The imports he values at £50,000, of which the value of the shawl-wool is £34,000. The manufacturing industry of the Punjaub is considerable. It is exercised principally in the silk and cotton productions of Amritsir, Lahore, Mooltan, Shoojahabad, Leia, and some other places in the south; the fabrication of arms in Lahore, and manufacture of leather and of arms in Cashmere. The imports from British India are principally sugar, spices, and other groceries; dye-stuffs, cotton, woollen, and silk cloths; metal, and utensils of various kinds of metal; ivory, precious stones, glass, porcelain, and crockery. The exports, whether in the way of transit or the produce of the country, are, grain, ghee, hides, wool, silk and cotton fabrics, carpets, shawls, silk, cotton, indigo, tobacco, gold, horses, and hawks."

Vol. II. page 132.

Alex. Burnes' MS. Commerce of Central Asia.

"The productions of the Punjaub are such, that it is relieved from dependence on external resources. A range of hills, extending from the Indus to the Hydaspes river, formed entirely of rock-salt, furnishes an inexhaustible supply of that material, and it is extensively exported. At the Mundu hills is another deposit of salt, some coal, and extensive iron fields, sulphur, nitre or saltpetre; also yooree, which gives the best charcoal.

The country is without copper, tin, brass, and lead. Keys, locks, padlocks, bolts, screws, hinges, &c., will have a steady sale. Woollen articles have become an object to the people. In this article alone the Company's factory sent up by the Indus a sufficient amount to realize a profit of five lacs of rupees annually."

Mr. Burnes, in describing the trade carried on with Cabool, represents that any encouragement held out to the Cabool merchants would be likely to increase the traffic. In speaking of the Bokhara trade, he specifies 200,000lbs. of tea as transported annually to Bokhara over land from China, the carriage of which takes many months; also of 2000 camel-loads of goods from British India, 500 pieces of Benares brocade, 2 lacs of rupees' value of shawls, and 500 camel-loads of indigo. Sugar, also, is an article of large import into Central Asia.

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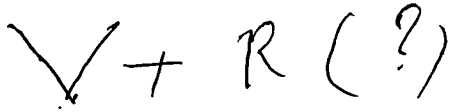

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